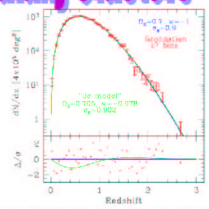
Dark Energy Camera and Survey

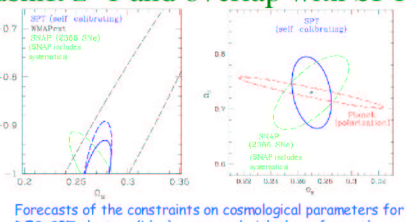
Response to NOAO Announcement of Opportunity for Blanco Instrumentation Partnership

Galaxy Clusters

Sample of ~30,000 clusters out to redshift z≈1 and overlap with SPT



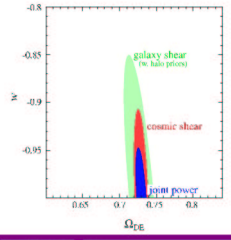
Model redshift distribution for the DES+SPT clusters (red, blue), and for a different cosmological model excluded at 3σ (green)



Forecasts of the constraints on cosmological parameters for the DES+SPT clusters (blue), compared with those from other samples. (from Majumdar & Mohr 2003a,b; Perlmutter & Schmidt 2003; Spergel et al. 2003; Eisenstein, Hu & Tegmark 1999)

Weak Lensing

Measurements of weak lensing shear-shear and galaxy-shear correlations for 10-20 galaxies per arcmin² and 5000 deg² of sky



68% C.L. contours on w and Ω_{DE} from shear-shear correlations (red), from galaxy-shear correlations (green), and from the joint constraint (blue). (from Hu, Frieman & Sheldon; cf. Hu & Jain 2003)

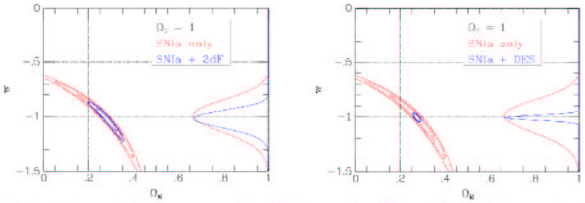
Galaxy Angular Power Spectrum

Measurement of angular power spectrum for ~300 million galaxies over 5000 deg², binned in photometric-redshift shells out to z~1.

Estimate 1σ constraint σ_w~0.1 on constant w models.

Type Ia Supernovae

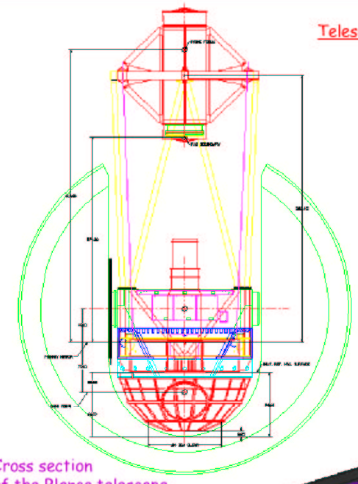
Light curves of ~2000 Type Ia SNe at z≈0.3-0.8 over 40 deg²



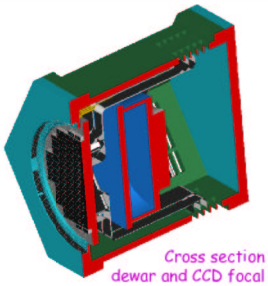
Projected constraints on w and Ω_M (flat cosmology) from the SN Ia sample only (red), combined with 2dF (blue, left), or combined with the DES+SPT clusters (blue, right). The right-hand curves in each panel marginalize over Ω_M. Follow-up spectroscopy assumed. (figures from Smith, Miknaitis & Suntzeff)

Telescope, Cage, and Camera

The existing 4m Blanco telescope at Cerro Tololo already provides imaging capabilities at its prime focus. We propose to replace the entire cage with an imager that will be over 10 times more powerful than the existing imager in the i and z bands.



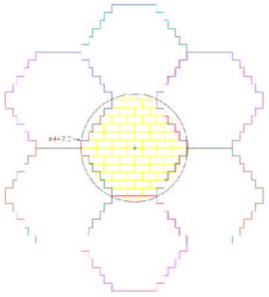
Cross section of the Blanco telescope showing the cage holding the Dark Energy Camera

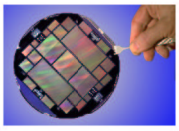


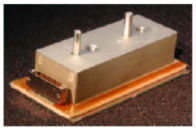
Cross section view of the dewar and CCD focal plane array

Focal Plane Layout

Our reference design consists of a mosaic of 62 CCDs covering a hexagonal FOV, with an effective area of 3 sq degrees for tiling the sky

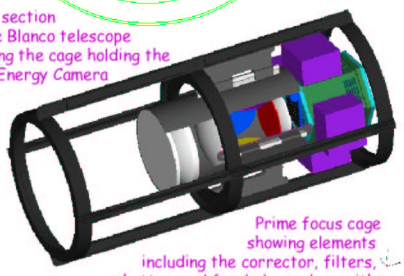




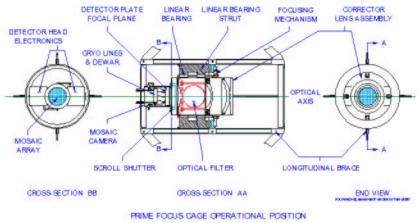


Photometric Redshifts

We require accurate galaxy photometric redshifts to z~1. Use g, r, i, z filter bands to be sensitive to the 4000Å break over the redshift range of interest.



Prime focus cage showing elements including the corrector, filters, shutter, and focal plane, along with various interfaces to the Blanco telescope.

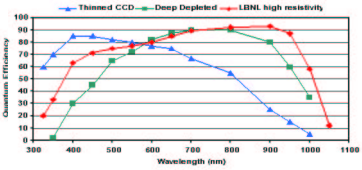


PRIME FOCUS CAGE OPERATIONAL POSITION

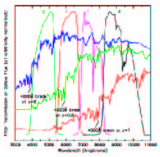
CCDs

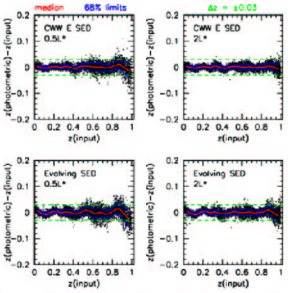
We require large format CCDs with high QE in the near IR (~1 μm). Our reference design uses LBNL developed thick (250μm), fully depleted 2K x 4K devices.

Typical QE curves of LBNL thick, high resistivity devices (red) which show higher QE in the red.



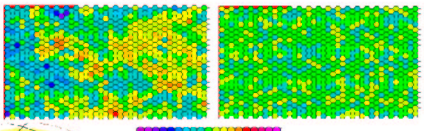
Spectrum of a red elliptical galaxy at z = 0, 0.5, and 1, with the 4000Å break feature marked. Also shown are the g, r, i, z filter bandpasses.

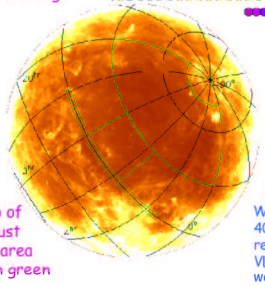




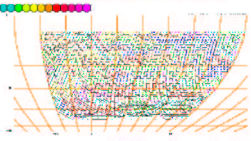
Monte Carlo simulations of photometric redshift accuracy for 0.5L* and 2L* red cluster galaxies. Photo-z errors are < 0.03.

Photometric calibration error after 3 and 5 yrs. The scale spans the range from -0.2 to 0.2 mag





Dirbe map of galactic dust with DES area outlined in green



Paths of constant airmass for one tiling

Survey Strategy

We plan to cover 5000 sq deg with tiling hexagons in the South Galactic Cap, with 4000 sq deg of overlap with the South Pole Telescope SZ cluster survey. Our reference survey area also includes equatorial regions that overlap existing SDSS and VLT redshift surveys. Historical weather data have been analyzed and indicate that we will be able to complete the survey in 5 years with a 3 sq deg FOV camera.

Dark Energy Camera and Survey

Fermilab, Univ. of Illinois, Univ. of Chicago, LBNL, Cerro-Tololo Inter-American Observatory